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SIMULTANEOUS QUADRATIC EQUATIONS.

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This discussion is restricted to the special cases of simultaneous quadratic equations of n variables which always admit of solution. It is assumed that solutions are always possible :

(1) When there is one equation of the second degree and one variable.

(2) When all equations except one are of the first degree.

Let $q, q_1 \ldots\ldots \ldots\ldots q_n$=terms of the second degree.

Let $p, p_1 \ldots\ldots\ldots\ldots p_n$=terms of the first degree.

Let $k, k_1 \ldots\ldots\ldots\ldots k_n$=absolute terms.

Let $l, l_1 \ldots\ldots \ldots\ldots l_n$=absolute terms.

Let m=a constant factor.

Let $x, x_1 \ldots\ldots\ldots\ldots x_n$=the variables.

Let $v_1, v_2 \ldots\ldots\ldots\ldots v_n$=the variables when the equations are transformed.

Case 1. When one equation is general, and the rest are of the first degree, or reducible to the first degree; *i. e.* when they assume any of the following forms :

$$(1)\qquad (p+k)^n=0.$$

$$(2)\qquad (p+k)(p_1+k_1)\ldots\ldots(p_n+k_n)=0.$$

$$(3)\qquad (p+k)^n+m(p_1+k_1)^n=0.$$

$$(4)\qquad (p+k)^{2n}+m(p+k)^n+l=0.$$

In the next four cases one or more of the equations may assume the above forms instead of the forms of these cases.

Case 2. When each equation can be resolved into two factors of the first degree and an absolute term and when one of these factors is common to all equations.

$$\left\{\begin{array}{c} (p+k)(p_1+k_1)+l_1=0. \\ (p+k)(p_2+k_2)+l_2=0. \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ (p+k)(p_n+k_n)+l_n=0. \end{array}\right\}$$

Eliminate the common factor. There are now $n-1$ equations of the first degree.

Case 3. When each equation can be resolved into two factors of the first degree and an absolute term and when each factor occurs in two equations.

As in the previous case, $n-1$ equations of the first degree can be obtained.

$$\left\{\begin{array}{l}(p_1+k_1)(p_2+k_2)+l_1=0.\\(p_2+k_2)(p_3+k_3)+l_2=0.\\\dots\dots\dots\dots\dots\dots\\(p_n+k_n)(p_1+k_1)+l_n=0.\end{array}\right\}$$

CASE 4. When like terms save the terms in which one variable occurs, are equal, or can be made equal in all equations. The terms can be made equal when the co-efficients of like terms are proportional in all equations, or when they are all similar and but one occurs in each equation. By eliminating these equal terms we can obtain $n-1$ equations in which the same variable will occur in each term. By dividing by this variable, we can reduce each of these equations to the first degree.

CASE 5. When like terms of the second degree are equal, or can be made equal, in all equations. Like terms can be made equal when they meet with the requirements indicated in Case 4. Eliminate the terms of the second degree. There are now $n-1$ equations of the first degree.

CASE 6. When the equations are homogeneous and like terms save those in which one variable occurs and the absolute term, are equal, or can be made equal in all equations. The requirements for making like terms equal are given in Case 4.

$$\left\{\begin{array}{l}p_1x+q+k_1=0.\\p_2x+q+k_2=0.\\\dots\dots\dots\dots\\p_nx+q+k_n=0.\end{array}\right\}$$

Let $x_1=v_1x$, $x_2=v_2x \ldots\ldots x_n=v_nx$. Eliminate x^2. We now have $n-1$ equations with $n-1$ variables which meet with the requirements of Case 5.

CASE 7. When two equations are homogeneous and the rest are of the first degree, or reducible to the first degree, with no absolute term. Eliminate all except two variables from the two homogeneous equations by means of the equations of the first degree. These two equations will then be homogeneous and will fall under Case 6.

CASE 8. When the terms containing one variable are equal, or can be made equal, in all equations and the remaining terms meet with the requirements of Case 6. Eliminate the terms containing this variable. We now have $n-1$ equations and $n-1$ variables which fall under Case 6.